

GPE Publication 2017-01

Patch-Burning Reduces Fuels and is Compatible with Prairie-Chicken Conservation

Written by: Heath Starns, Oklahoma State University

INTRODUCTION

The Great Plains of North America has experienced exponential increases in wildfires since 1985, with a 400% increase in area burned and more than 300% increase in number of wildfires (Donovan et al. 2017). Since 2002, wildfires have burned more than 40 million hectares (100 million acres) in the southern Great Plains (Kansas, New Mexico, Oklahoma, and Texas) as a result of long-term alterations to plant communities and fire regimes. These included record-setting fires which caused extensive damage to property, as well as loss of human lives. In 2006, the East Amarillo Complex Fires burned nearly 400,000 ha in 24 hours. In 2011, the southern Great Plains

region accounted for 51% of the area burned in the entire U.S. (NIFC 2017). The Anderson Creek Fire in 2016 was the largest fire in Kansas history, until the Starbuck Fire in 2017 burned more than 161,000 ha in Kansas, after burning 80,000 ha in Oklahoma where it began. These and other fires have illustrated the need for an effective strategy to manage fuels in the region. Prescribed fire is becoming increasingly popular as a management strategy, and is projected to be the dominant fuels management strategy for federal land management agencies in the future (National Strategy 2014). However, rapid recovery of vegetation in the southern Great Plains would demand frequent (possibly annual) prescribed fire

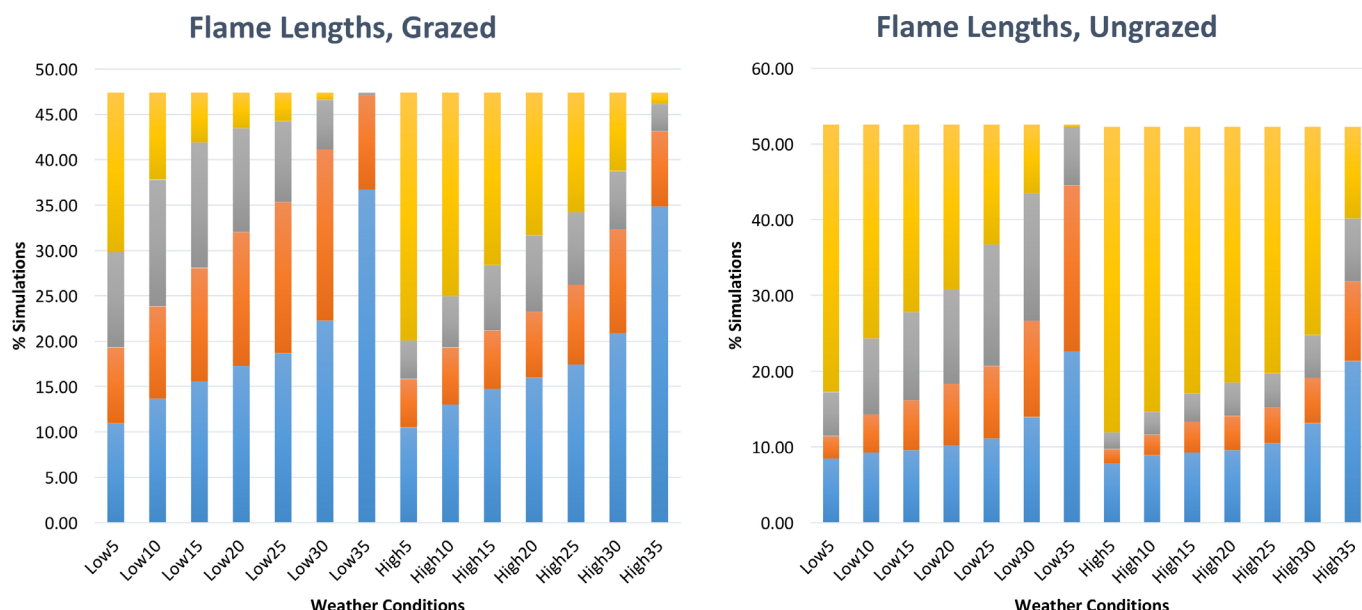


Figure 1. Percentages of fire simulations within each fire management threshold associated with effectiveness of wild-land firefighting techniques for pyric herbivory (grazed) and fire-only (not grazed) treatments. Weather conditions simulated were wind speeds 16 km per h (Low) and 40 km per h (High), and fuel moistures from 5% to 35%. Blue bar= flame lengths ≤ 1.4 m, orange= flame lengths 1.41–2.4 m, gray= flame lengths 2.41–3.4 m, yellow= flame lengths ≥ 3.41 m.

to keep fine fuels low. Because maintaining a high diversity of wildlife requires that a diverse array of vegetation composition and structure be present in an area, such frequent treatments could reduce diversity of plants and animals (Collins 1992; Fuhlendorf et al. 2017a). Perhaps one of the most prominent examples of this is the prairie-chicken (*Tympanuchus* spp.), which require very different vegetation structures for different portions of their life history (Fuhlendorf et al. 2017c).

One potential solution to this dilemma is to restore the interaction of fire and grazing to mediate fine fuel accumulation, break up landscape fuel continuity, and provide a mosaic of vegetation patches to accommodate biodiversity. Pyric herbivory is the practice of allowing large grazers to selectively graze recently burned areas while minimizing grazing pressure on patches with greater time-since-fire. Pyric herbivory is the interaction between fire and grazing, and has been suggested as a rangeland management strategy that promotes heterogeneity across the landscape through a complex set of positive and negative feedbacks, ultimately increasing biodiversity (Fuhlen-

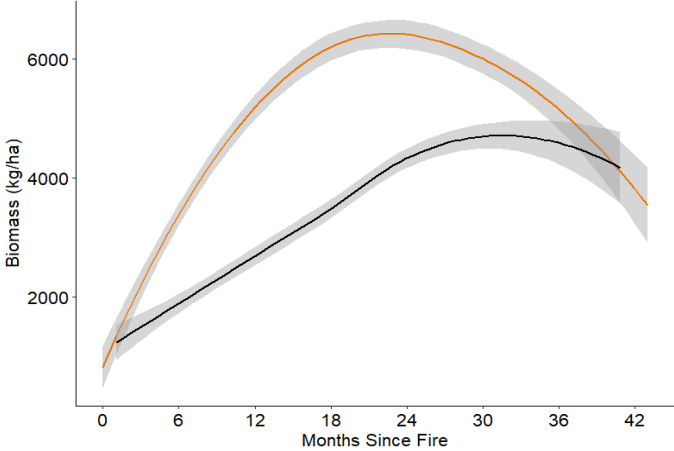


Figure 3. The orange line represents mean aboveground biomass (kg per ha) with increasing months since fire for fire-only (not grazed) and the black line represents pyric herbivory (grazed) treatments. Shaded areas show 95% confidence intervals.

dorf et al. 2009; Hovick et al. 2014). Our goal was to assess the potential for pyric herbivory to reduce fuel loads while simultaneously promoting the landscape heterogeneity required by lesser (*T. pallidicinctus*), greater (*T. cupido*), and Attwater’s prairie-chickens (*T. c. attwateri*).

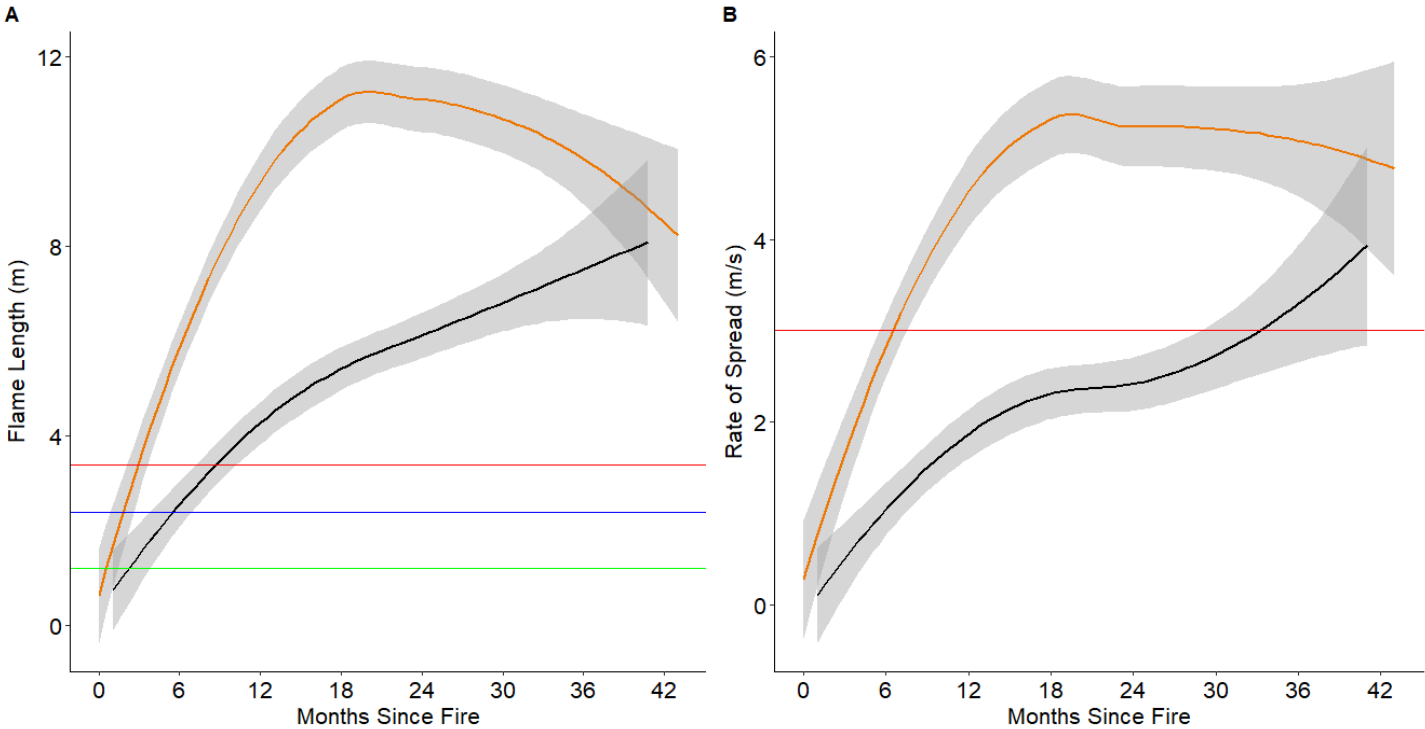


Figure 2. Simulated flame lengths (A) and spread rates (B) in fire-only (not grazed) and pyric herbivory (grazed) treatments for fires simulated with weather conditions of 40 km per h wind and 5% fine fuel moisture. On panel A, the green horizontal line indicates the maximum threshold (1.4 m) at which hand tools are effective for fighting wildland fires. The blue horizontal line indicates flame length at which aerial and heavy equipment effectiveness diminishes (2.4 m). The red horizontal line indicates the threshold at which standard wildland firefighting techniques become ineffective (3.4 m). The orange lines represent fire-only treatments and black lines represent pyric herbivory treatments.

FIRE

A previous fire behavior study established the use of high and low spread rate scenarios to identify differences in fire behavior for changing environmental conditions (Twidwell et al. 2016). We extended this approach to fire suppression capabilities. We simulated fires using dynamic fuel models customized by inputting fuels data collected from the Attwater's Prairie-chicken National Wildlife Refuge, Aransas National Wildlife Refuge, Packsaddle Wildlife Management Area, and the Tallgrass Prairie Preserve in the southern Great Plains using 2 different wind speeds (16 and 40 km/h) and 7 levels of fuel moisture (5-35%). From the simulation output, we assessed differences in fire behavior characteristics relative to time-since-fire based on the management strategy used (pyric herbivory vs. fire-only). Results were compared to known flame length thresholds (<1.41m, 1.41-2.41m, 2.41-3.4m, >3.4m) for effectiveness of standard wildland firefighting techniques (NWCG 2014).

We found that pyric herbivory sites accumulated fine fuel at a lower rate than sites treated with fire only (Figure 1). The fuel accumulation observed in fire-only treatments was sufficient to render standard firefighting techniques ineffective in as few as 4 months. Pyric herbivory treatments maintained lower spread rates and flame lengths below the 3.4 m critical threshold for up to 8 months under our most extreme simulated weather conditions (Figure 2). As conditions became less extreme, the benefits of pyric herbivory were more pronounced. Under extreme conditions (high wind and 5% fuel moisture), 79% of transects in fire-only treatments versus 58% in pyric herbivory treatments had flame lengths greater than 3.4 m, which are beyond the limits of standard control methods. With the same wind speed and 10% fuel moisture, the difference between fire-only and pyric herbivory was even greater (74% vs. 47%, respectively; Figure 3).

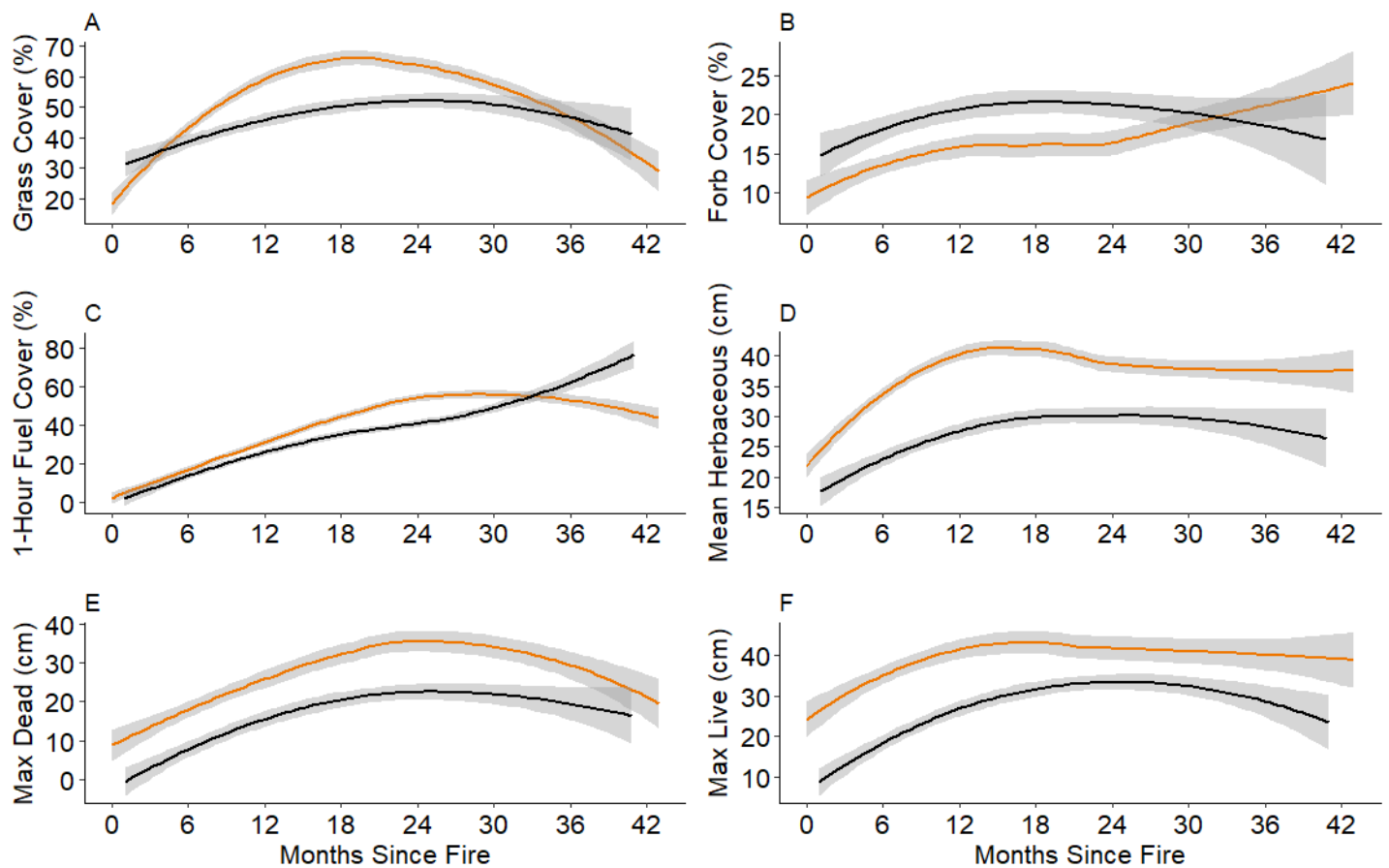


Figure 4. Comparison of percent grass cover (A), percent forb cover (B), percent cover of 1-hour fuel (C), mean height of herbaceous plants (D), maximum dead vegetation height (E), and maximum live vegetation height (F) for fire-only and pyric herbivory treatments. The orange lines represent fire-only treatments and black lines represent pyric herbivory treatments.

PRAIRIE-CHICKENS

Prairie-chickens require short vegetation or bare ground for lekking, grass heights 19-49 cm and 12-21% cover for nesting, and abundant forbs with bare ground for brooding (Hagen et al. 2004; USFWS 2010; Fuhlendorf et al. 2017b). We collected data on vegetation structure at each site for comparison to these known habitat requirements of prairie-chickens. We found differences between treatments in percent cover of forbs and grass, as well as differences in maximum height of live and dead vegetation and mean height of shrubs and herbaceous plants (Figure 4). Pyric herbivory maintained vegetation structure and composition within the recommended guidelines for suitable prairie-chicken habitat. Percent cover of grasses recovered more slowly and was lower in pyric herbivory treatments. Forb cover (%) was generally higher in pyric herbivory treatments, although both treatments had values of forb cover well above the minimum recommendation for prairie-chicken habitat. Because prairie-chickens use areas of approximately 25-50% grass cover and 10-35% forb cover for brood-rearing activities (Hagen et al. 2004; USFWS 2010), our data indicate that patch-burning provides suitable brooding habitat for a longer time than fire-only treatment. Litter and bare ground were similar for the two treatments. Vegetation height was shorter in pyric herbivory than fire-only treatments, but still suitable for each life stage of prairie-chickens. Percent cover of litter, bare ground, and shrubs was similar for pyric herbivory and fire-only treatments.

MANAGEMENT IMPLICATIONS

We found few differences in suitability of vegetation as prairie-chicken habitat between pyric herbivory and fire-only treatments. This is likely a result of the patchy pattern with which fires were performed in both treatments. Our results suggest that pyric herbivory is a viable fuels management technique in the southern Great Plains, especially when conservation goals must also be considered. Even when extreme conditions were simulated, pyric herbivory extended the window of time in which standard firefighting techniques were effective. Subtle changes in simulated weather conditions, consistent with changes typically observed as a result of nightfall (lower wind and increased fuel moisture), led to more significant changes in fire

behavior in pyric herbivory treatments than in fire-only treatments. Such differences suggest the effectiveness of suppression efforts would be greatly improved by large-scale implementation of pyric herbivory.

Furthermore, we found that pyric herbivory maintained the diversity of vegetation structure required by prairie-chickens to carry out all life stages, which has also been recommended for increasing diversity of other rangeland species (Fuhlendorf et al. 2017a).

REFERENCES

- Collins, SL (1992) Fire Frequency and Community Heterogeneity in Tallgrass Prairie Vegetation. *Ecology* 73, 2001-2006.
- Donovan, VM, CL Wonkka, D Twidwell, (2017) Surging wildfire activity in a grassland biome. *Geophysical Research Letters*
- Fuhlendorf, SD, DM Engle, J Kerby, R Hamilton, (2009) Pyric Herbivory: Rewilding Landscapes through the Recoupling of Fire and Grazing. *Conservation Biology* 23, 588-598.
- Fuhlendorf, SD, RW Fynn, DA McGranahan, D Twidwell, (2017b) Heterogeneity as the Basis for Rangeland Management. In 'Rangeland Systems.' pp. 169-196. Springer.
- Fuhlendorf, SD, TJ Hovick, RD Elmore, AM Tanner, DM Engle, CA Davis, (2017c) A Hierarchical Perspective to Woody Plant Encroachment for Conservation of Prairie-Chickens. *Rangeland Ecology & Management* 70, 9-14.
- Hagen, CA, BE Jamison, KM Giesen, TZ Riley, (2004) Guidelines for managing lesser prairie-chicken populations and their habitats. *Wildlife Society Bulletin* 32, 69-82.
- Hovick, TJ, RD Elmore, SD Fuhlendorf, (2014) Structural heterogeneity increases diversity of non-breeding grassland birds. *Ecosphere* 5, 13.
- National Strategy, 2014. National Cohesive Wildland Fire Management Strategy.
- NIFC (2017) 'National Interagency Fire Center.' Available at https://www.nifc.gov/fireInfo/fireInfo_stats_lgFires.html [Accessed February].
- NWCG, 2014. Incident Response Pocket Guide.
- Twidwell, D, AS West, WB Hiatt, AL Ramirez, JT Winter, DM Engle, SD Fuhlendorf, JD Carlson, (2016) Plant Invasions or Fire Policy: Which Has Altered Fire Behavior More in Tallgrass Prairie? *Ecosystems* 19, 356-368.
- USFWS, 2010. Attwater's Prairie-Chicken Recovery Plan, Second Revision. Attwater's Prairie-Chicken Recovery Plan, Second Revision.